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The relevance of zinc determination in amniotic fluid 2nd Communication: Zinc in cases of high fetal risk

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The importance of an adequate zinc supply to mother and fetus for an undisturbed pregnancy is undisputed today. By means of experiments on animals fed on a low-zinc diet it was possible to provoke a large number of diseases and syndromes. Malnutrition tests on rats showed neurological malformations (exencephalus, hydrocephalus), tissue abnormalities, high deformity rate of practically all organs and parts of the body and greatly reduced birthweights [8, 17]. In addition to obvious malformations such as clubbed feet and scull deformities, other not so obvious defects such as mucosa-defects can be observed in the oesophagus [2]. When the rats had been previously fed on a low-zinc diet, there was a very noticeable reduction in the mating desire of the females and in the other cases the already high rates of abortion increased so much that no healthy animals were born at all [1]. Low-zinc feeding after the birth of the rats gives rise to reduction in the milk-production. The milk produced is low in zinc and the serum-zinc levels fall rapidly in the young rats. This results in diminished growth and increased mortality [12]. The most important result emerging from these tests is however that the pregnant rat is clearly not able to store up enough zinc (Zn) to balance out a longer non-recipient period and to supply the fetus with the stored-up zinc [9]. Severe consequences are shown to occur after even only one or two weeks of a low-zinc diet [8]. Tests made on pregnant cows, to whom radiozinc (65 Zn) had been administered, produced important information on this point. Within a week only 14% of the absorbed radiozinc was supplied to the fetus and the plazenta by the mother [7]. Further tests on other animal species did not supply any results contrary to those given above [6]. As in rats [9], in human beings the liver – which is reckoned as being one of the organs most rich in zinc – also does not appear to act as a zinc storage unit [6, 18]. There exists a direct proportionality between the zinc level of the mother's and the fetus's liver, than means, when the zinc concentration diminishes in the liver tissue in the mother then is also diminishes in the fetal liver tissue [15].

The facts listed go further to prove that precisely during pregnancy an alimental zinc deficiency can very quickly bring about a general zinc inadequacy situation. However up to now there exist no possibilities of recognizing such inadequacy situations in good time, let alone treating them.

1 Objectives

The examination had to be made in order to establish to what extent there exists a correlation between fetal malnutrition, zinc content and also the total protein content of the amniotic fluid (AF). For this purpose test methods described in Part I of this communication were adopted [10]. These were atomic absorption spectrophotometry for the zinc measurement and a Biuret method adapted for the amniotic fluid for the total protein measurement. Risk-collectives had to be examined and the results compared with a control group. In this way an answer was to be found to the question as to whether the allocation of zinc and possibly also protein in the amniotic fluid are suitable methods of early detection of fetal risk factors. Through examination of particular risk-groups it had to be proved which factors change the amniotic

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fluid zinc level (AFZL), what these changes are, and whether a differentiation can be undertaken as to the initial cause. In this way conditions for a therapeutical intervention should be established.

2 Results

More than 500 deep-frozen (–20°C) amniotic fluid samples were available for the investigations. The samples were obtained by amniocentesis during pregnancy, by puncturing the membrane to induce the birth or during the course of delivery.
In contrast to serum and red cell zinc levels [11], the AFZL are not supposed to be dependent on the age of the mother [10], and therefore it was not necessary to make an age composition. Each case from which amniotic fluid was available was examined to see if anything unusual had occurred during the pregnancy and during the newborn period. All cases which veered away from the normal pregnancy course were assigned to the corresponding risk-collectives. The diagnoses listed in Table I belonged to this group.

Tab. I. Syndromes which were examined for deviations in the zinc level of the amniotic fluid.

Hypotrophic newborns	Diabetes mellitus (different classes)
Hypertrophic newborns	
Multiple births	Gestosis (EPH)
Deformities (anencephalus, hydrocephalus, spina bifida, hydrocele, lunghypoplasie, etc.)	Green amniotic fluid
	Hemorrhagic AF
	Intrauterine fetal death

All cases which were not assigned to a group listed in Tab. I, that is whose pregnancy course was not unusual, were included in the control group. The main indications for sampling the amniotic fluid in these patients were: Diagnosis of lung-maturity, premature labour, high rupture of the membrane, genetic examinations and tocolysis.
For each syndrome examinations of the correlation of the weeks of gestation (WG) were made – in so far as there were enough cases available. This group included: Hypotrophic fetuses, diabetes mell., gestosis and cases with green amniotic fluid. For these cases the median values and the 10th and 90th percentiles were reckoned. For statistical investigation the results were compared with the corresponding levels in the control group with the help of the U-test according to MAN, WHITNEY and WILCOXON. For those groups in Tab. I where the number of cases was too small, only the trend was established. In order to allow a differentiation between hypo- and hypertrophic fetuses, the birth weight, dependent on the WG was in each case provided by a percentile status symbol according to SALING (still not published) using NICKL's [13] intrauterine weight standards. Fig. 1 shows this scheme as developed in our clinic. According to this, normal cases receive the symbol P IV. They lie between the 25th and 75th percentile level. Severely hypotrophic fetuses however, lying below the 3rd percentile receive the symbol P I-. Fig. 2 shows the median of the AFZL dependent on the WG. The median curve of the control group was derived from 230 amniotic fluid samples from different patients. The median curve for severe hypotrophy covers 42 cases with the percentile status P I-, whereas the curve of the zinc level of all the hypotrophic cases covers 140 tests of hypotrophy of all levels of severity. According to the U-test **the zinc levels of the amniotic fluid in cases of mild or severe hypotrophy from the 38th WG onwards are significantly lower ($p < 0{,}01$) than those of the comparison collective.** It is not possible to differentiate statistically between cases of mild and severe hypotrophy. The difference in the median levels of normal and hypotrophy cases from the 38th WG onwards lies at about 0,05 µg Zn/ml AF.

Suitable experiments were undertaken to clarify the question as to whether differences can also be established in the overall protein levels of the amniotic fluids between cases of hypotrophic fetuses and the comparison collective. The results are shown in Fig. 3 with the median levels of the control group compared to the hypotrophy cases (P I- to P III-). **A significant difference is not to be found.** The comparison on cases of severe hypotrophy (P I-) provided a similar picture. The control group of 197 pregnancies was compared with 123 cases of hypotrophy at all levels of severity.

Fig. 4 shows the AFZL in patients with **gestosis or diabetes mell.** compared to the control group dependent on the WG. 36 cases of EPH-gestosis

PERCENTILE STATUS				
normal	*hyper*troph range of percentiles	*hypo*troph	percentilestatus symbols	classification
25. – 74.			P IV	normal
	75. – 89.	10. – 24.	P III+ / P III–	still normal
	90. – 96.	3. – 9.	P II+ / P II–	slight deviation
	⩾ 97.	< 3.	P I+ / P I–	severe deviation

Intrauterin weight standards (Nickl)

gestational age	3.	10.	25.	50.	75.	90.	97.
				percentile			
28/0–28/6	720	890	1070	1190	1310	1790	1980
29/0–29/6	950	980	1250	1370	1630	1800	2250
30/0–30/6	790	930	1250	1680	1820	2020	2700
31/0–31/6	960	1200	1540	1730	1930	2110	2780
32/0–32/6	1250	1520	1670	1750	1930	2100	2820
33/0–33/6	1470	1560	1820	1990	2230	2440	3390
34/0–34/6	1490	1600	1930	2240	2670	3050	3230
35/0–35/6	1660	1850	2220	2450	2910	3370	3770
36/0–36/6	1960	2200	2500	2880	3200	3410	3600
37/0–37/6	2180	2560	2780	3000	3300	3550	3810
38/0–38/6	2460	2710	2940	3200	3470	3700	3900
39/0–39/6	2590	2870	3050	3300	3600	3850	4150
40/0–40/6	2700	2970	3180	3480	3740	4000	4280
41/0–41/6	2730	2960	3210	3500	3800	4060	4330
42/0–42/6	2600	2850	3150	3470	3760	4080	4480

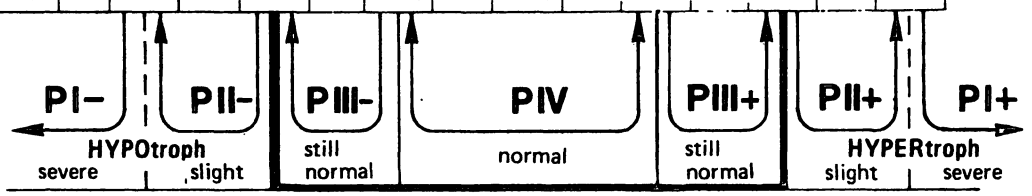

Fig. 1. Percentile status according to SALING (still not published) using NICKL's [13] intrauterine weight standards.

at various levels were examined. The course of the curve differs clearly from that of the control group and the diabetics. About the 32nd to 33rd WG the AFZL in the gestosis group are significantly higher ($p < 0,05$) than in the control group. They then sink not only relatively in comparison with the control group but also totally, and about the 40th to 41st WG lie significantly below the corresponding levels of the control group ($p<0,05$). The examination of 61 patients with diabetic metabolism however produced a different result. As shown in Fig. 4 the curve for the diabetics lies under the control group in all the pregnancy periods examined. The difference is significant

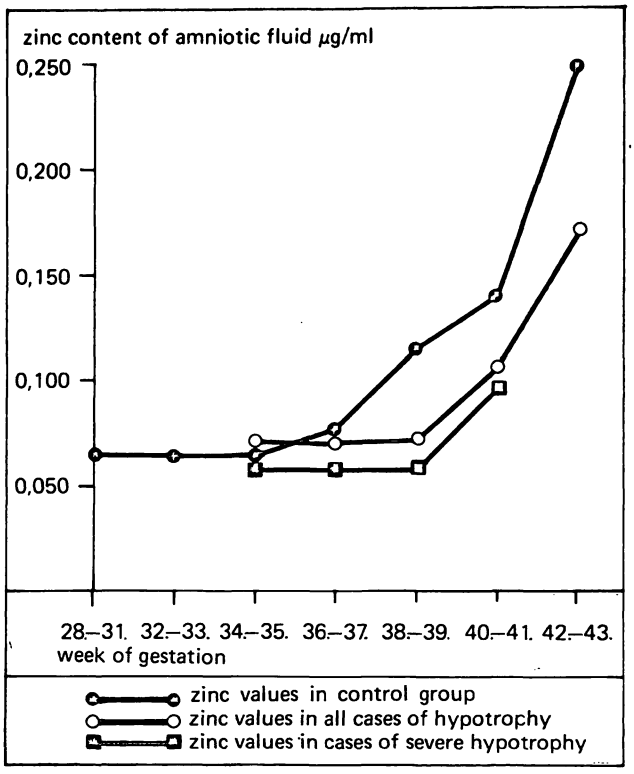

Fig. 2. Zinc content of the amniotic fluid dependent on the week of pregnancy in cases of hypotrophy compared to the control group.

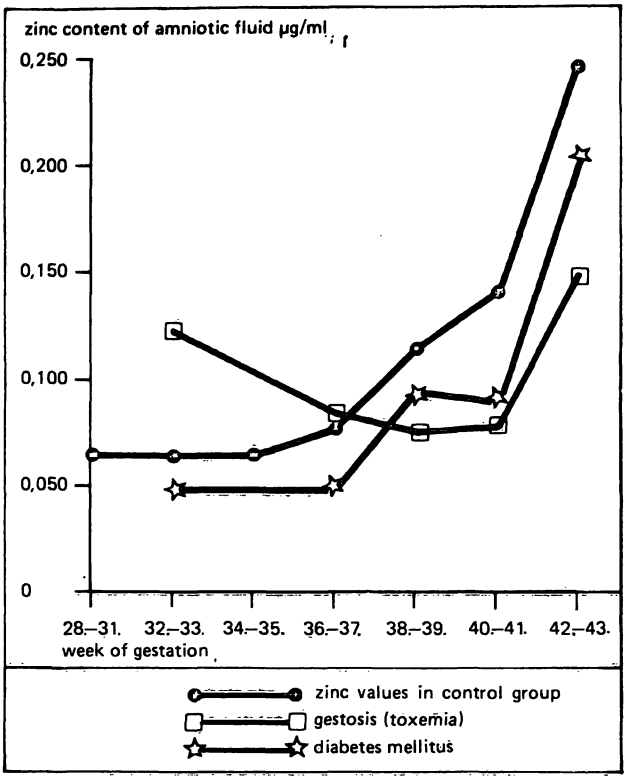

Fig. 4. Zinc content of the amniotic fluid dependent on the week of pregnancy in cases of gestosis or diabetes mellitus compared to the control group.

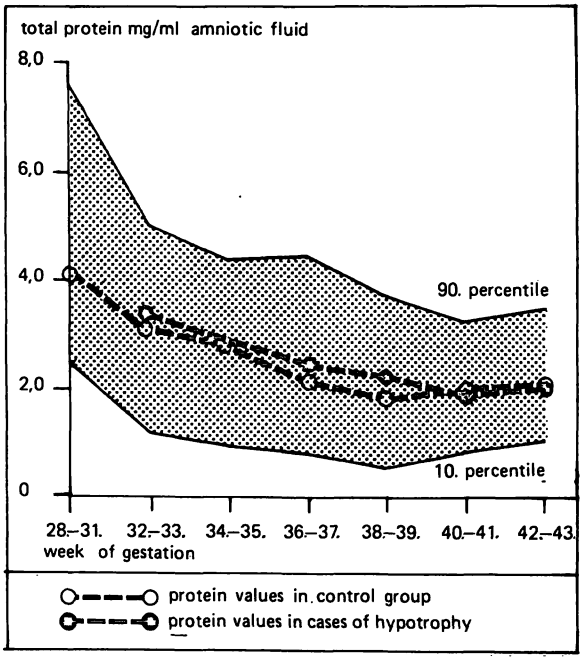

Fig. 3. Total protein content of the amniotic fluid dependent on the week of pregnancy in cases of hypotrophy compared to the control group.

($p < 0,05$) after the 39th WG. The differences in median levels measure about 0,05 µg Zn/ml AF.

As a guideline, the protein content of the amniotic fluid was also calculated in cases of gestosis and diabetis mellitus. Without carrying out statistical analysis, a tendency to higher levels in the middle trimenon was recognised in the gestosis group as against lower levels in the control group from the 38th WG onwards. In the diabetic group lowered protein levels were measured in the whole period between the 28th and 43rd WG.

In Fig. 5 the zinc levels obtained from clear fluid samples or that containing vernix are compared with the zinc content of 98 cases where mekonium was contained in the amniotic fluid. The result was that from the 38th WG onwards the zinc content of the green amniotic fluid lies significantly higher ($p < 0,05$).

In further groups of risk pregnancies, where however the number of cases was too small to undertake statistical calculations, the following tendencies were seen to emerge: In 9 cases of twin preg-

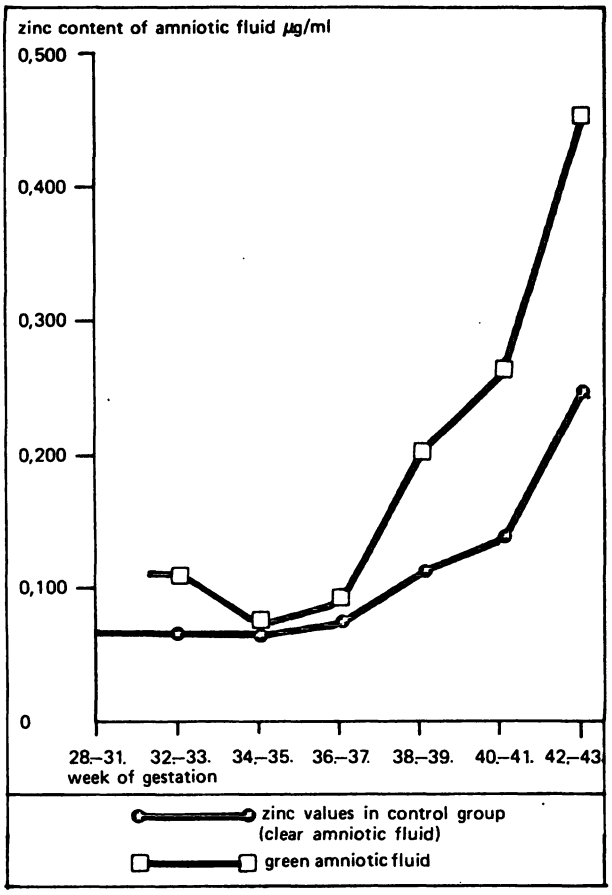

Fig. 5. Zinc content of the amniotic fluid dependent on the week of pregnancy in amniotic fluid containing meconium, compared to the control group.

nancies the examination of the amniotic fluid for zinc content gave levels which lay between the 20th and 50th percentile level of the control group. In one case with two amniotic cavities the amniotic fluid examination gave almost identical zinc levels for both samples. Two cases of hydramnion showed lower levels. In 5 cases of intrauterine fetal death a tendency towards higher zinc levels could be established, particularly when the death of the fetus had taken place some days previously. The examination of 16 hemorrhagic amniotic fluid samples brought no increased zinc levels.

3 Discussion

The investigations prove that the significant increase in the zinc content of the amniotic fluid after the 37th WG to about three times the initial level [10] in cases of mild or severe hypotrophy occurs only to a lesser degree, so that towards the end of the third trimenon the AFZL lie clearly below those in the control group (Fig. 2).

Since the zinc level calculation through atomic absorption spectrophotometry is quick, precise and specific it opens up new possibilities for the complete biochemical control of the fetal condition. Cases of various types of gestosis and diabetis mell. at various classes which occur very often in the pregnancy risk-collective, cause – as does hypotrophy – a reduction in the rise of the AFZL (Fig. 4). In future the zinc level measurement could be included as a complementary diagnosis for all these syndromes. Increased AFZL were observed in our tests after the 36th WG only in green amniotic fluid and intrauterine fetal death, both of which conditions can be easily recognized. The 10th percentile of the control group runs at 0,04 µg Zn/ml AF in the 37th WG, and reaches a level of 0,14 µg Zn/ml AF in the 42nd. Thus levels lying below this line during this period can be regarded as suspect due to negative influences through hypotrophy, diabetis mell. or gestosis. HÄHN and FUCHS [4] in their investigation on the zinc content of the serum, proved that from the 36th WG onwards the serum zinc level in women with severe gestosis decreases more sharply than in normal cases. From the 36th WG on, this difference is significant at $p < 0{,}01$. The mean value reaches its minimum in the 40th WG with 0,59 µg Zn/ml serum. So there is similar behaviour of zinc concentration in the serum of the mother and the amniotic fluid, with the difference that the zinc content of the serum does not increase in late pregnancy in the control groups, whereas a rise can be established in the AFZL. The reaction of the trace element copper in the mother's serum in cases of gestosis however shows a completely opposite picture. A report of the copper content of the amniotic fluid will be published later.

The authors named [4] explain the decrease in the serum zinc level with the high loss of protein of gestosis patients during pregnancy. This applies particularly to the loss of albumin to which a third of the zinc in the serum should be combined. The same explanation could be applied to the decrease of AFZL in cases of gestosis after the 39th WG.

It is well known that the fetus produces urine in

large quantities during the third trimenon. Therefore as a reason for the significantly increased AFZL of gestosis patients around the 32nd WG the possibility arises that correspondingly the mother's and fetal urine contain an increased proportion of protein, and together with it the zinc is discharged at increased levels. As a result during the further course of pregnancy a zinc deficiency occurs with corresponding decrease of the AFZL.

In a previous work [10] the interdependence of the protein content of the amniotic fluid and gestational week was determined. Thereafter the protein level decreased clearly up to the 39th WG, and then remained more or less constant. In a similar test on the control group undertaken for this work, for which not five but rather two WGs were combined, there emerged a tendency to an increase of the protein content of the amniotic fluid after the 38th WG; however, this tendency could not be statistically supported because of the wide variations. Nevertheless FENNEFROHN [3] was able to prove a significant increase in protein and albumin after the 38th WG. Thus it appears proven that towards the end of a pregnancy the zinc and protein content of the amniotic fluid react similarly in principal.

The important function of zinc against bacterial activity of the amniotic fluid is well known. It is thought that zinc due to its similar ionic radius and charge interferes in the magnesium dependent biosynthesis steps of the metabolism of the bacteria. Therefore it is also understandable that a higher phosphate content in the amniotic fluid due to the development of unsoluble zinc phosphate has a negative effect on the bacteriostasis. After the results of the previous work, the question is posed as to whether the observed decrease in the zinc content of the amniotic fluid in the various diseases and syndromes tested, produces yet another additional danger to the fetus due to the increased risk of a bacterial infection. Further tests must provide clarity on this point. It remains to be proved in how far the zinc calculation can be applied as an indicator of a threatened intrauterine infection and thereby increased danger of intrauterine fetal death. The observation made by TAFARI et al. [16] that in almost one third of all perinatal deaths in a tested collective in Addis Abeba an inadequate bacteriostasis of the amniotic fluid was established, gives certain indications in this direction.

The original idea that zinc deficiency in human nutrition through the widespreading of this trace element is not to be expected, had to be revised after the investigations made by HALSTED et al. [5] and REINHOLD et al. [14]. Insufficient zinc supply to the organism leads among many other disturbances to a diminished growth or even to dwarfism. Many experiments made on animals and tests made on human beings have proved that the human organism has a very limited storage capacity and no real storage organ for zinc. The conclusion, that zinc deficiency in pregnancy can lead to diminished growth of the fetus is not far off. Therapeutical tests have shown that zinc deficiency caused by malnutrition and even some diseases and syndromes react quickly and successfully to an oral or parental zinc therapy. Should it later be possible to recognize zinc deficiency early in pregnancy, then the outlook appears quite favourable for therapeutic interventions.

Summary

Extensive tests on animals and tests on human beings have established that the storage capacity of the organism for zinc (Zn) is very limited and that there exists no proper storage organ for this trace element. Particularly during pregnancy a nutritional zinc deficiency therefore quickly brings about a general zinc deficiency situation. Up to now however it has not been possible to recognize these deficiencies in time, let alone to treat them. In this investigation we tested to what extent there exists a correlation between fetal malnutrition and the zinc content or total protein content in the amniotic fluid (AF). For this purpose we used methods described in Part I of this publication [10]. These were atomic absorption spectrophotometry for the zinc measurement and a Biuret method adapted for the amniotic fluid for the total protein measurement.

Various risk-collectives were examined and the results were compared with 230 cases of a control group. The results show, **that the significant increase in the zinc content of the amniotic fluid in the control group from the 38th week of gestation (WG) onwards to about three times as much as the initial level, occurred only in weak form in 123 cases of mild or severe hypotrophy.** So the amniotic fluid zinc levels (AFZL) lie clearly lower towards

the end of the third trimenon than in the control group. The difference according to the U-test at $p < 0,01$ is significant. The concentration difference from the 38th WG onwards lies at about 0,05 µg Zn/ml AF.

The calculation of the total protein content of the amniotic fluid does not appear to be a suitable method of recognizing a hypotrophy, since it does not show a significant difference from the control collective. However, towards the end of the pregnancy zinc and protein content show the same tendency. 36 cases with **EPH-gestosis** showed – in comparison with the control group – around the 32nd to 33rd WG significantly higher, and around the 40th to 41st WG significantly lower levels of zinc ($p < 0,05$). The explanation for this is in our opinion due to the increased protein mobilisation following the protein loss, which, on account of the high albumin linking of zinc, is combined with a zinc loss.

However tests on the amniotic fluid of 61 patients with **diabetic metabolism** conditions brought another result. Here zinc levels lie **below** those of the control group during the complete pregnancy period tested. After the 39th WG the difference is significant ($p < 0,05$). The 10th percentile of the control group goes up to 0.04 µg Zn/ml AF in the 37th WG and reaches the level of 0,14 µg Zn/ml AF in the 42nd week. Levels lying below this line can be regarded as suspect due to negative influences through hypotrophy, diabetis mell. or gestosis. Increased AFZL occur after the 34th WG only in cases of intrauterine fetal death or green amniotic fluid. Furthermore zinc has an important function for the antibacterial activity of the amniotic fluid. For example, **the zinc levels of the amniotic fluid are reduced in the amnionic infection syndrome.** Therefore the calculation of the AFZL could be of importance to the early diagnosis of such infections.

The long held view that zinc deficiency in human nutrition is not to be expected through the widespreading of this trace element, must be revised today. Insufficient zinc supply to the organism clearly leads – among other disturbances – to a diminished growth, which according to the foregone investigations also appears to have a great importance on pregnancy. Experiments on animals and therapy tests on groups of people with zinc deficiency supply have shown that the alimentary zinc deficiencies and even some medicinal or disease disturbances do respond quickly and successfully to an oral or parental zinc therapy. An early detection of zinc deficiency during pregnancy could therefore open new possibilities of treatment.

Keywords: Amniotic fluid, diabetes mellitus, fetal supervision, gestosis, hypotrophy, malnutrition, proteins, risk pregnancy, zinc.

Zusammenfassung

Die Bedeutung der Zinkbestimmung im Fruchtwasser. II. Mitteilung: Die Bestimmung von Zink im Falle fetaler Gefährdung.

Umfangreiche Tierversuche und Untersuchungen am Menschen haben bewiesen, daß die Speicherfähigkeit des Organismus für Zink (Zn) sehr begrenzt ist und es kein eigentliches Speicherorgan für dieses Spurenelement gibt. Gerade in der Schwangerschaft führt ein alimentärer Zinkmangel deshalb schnell zu einer allgemeinen Zinkmangelsituation. Bis heute fehlen jedoch die Möglichkeiten, solche Mangelzustände rechtzeitig zu erkennen oder gar zu therapieren. In der vorliegenden Arbeit wird untersucht, inwieweit eine Korrelation zwischen fetaler Mangelversorgung und dem Zinkgehalt bzw. dem Gehalt an Gesamt-Protein des Fruchtwasser (AF) besteht. Hierzu wurden die im Teil I dieser Veröffentlichung beschriebenen Untersuchungsmethoden angewandt [10]. Es wurden verschiedene Risikokollektive untersucht und die Ergebnisse mit 230 Fällen einer Kontrollgruppe verglichen. Die Ergebnisse zeigen, daß der im Kontrollkollektiv signifikante Anstieg des Zinkgehaltes des AF nach der 37. Schwangerschaftswoche (GW) auf etwa das dreifache des Ausgangswertes bei 123 Fällen von leichter oder schwerer Hypotrophie nur in abgeschwächter Form erfolgt, so daß die Fruchtwasserzinkwerte (AFZL) gegen Ende des dritten Trimenons deutlich tiefer liegen als in der Kontrollgruppe. Der Unterschied ist nach dem U-Test mit $p < 0,01$ signifikant. Die Konzentrationsdifferenz liegt von der 38. GW ab bei etwa 0,05 µg Zn/ml AF.

Die Bestimmung des Gesamtproteingehaltes des AF erscheint nicht als geeignete Methode zur Erkennung einer Hypotrophie, da sich zum Kontrollkollektiv keine signifikanten Unterschiede ergeben.

36 Fälle mit EPH-Gestose zeigten im Vergleich zur Kontrollgruppe im Bereich der 32. bis 33. GW signifikant erhöhte, im Bereich der 40. bis 41. GW signifikant tiefere Werte ($p < 0,05$). Die Erklärung hierfür ist unserer Meinung nach die erhöhte Eiweißmobilisierung und der nachfolgende Eiweißverlust, der aufgrund der hohen Eiweißbindung des Zn mit einem Zinkverlust kombiniert ist.

Die Untersuchung des AF von 61 Patientinnen mit diabetischer Stoffwechsellage erbrachte dagegen ein anderes Ergebnis. Hier liegen die Zinkwerte im gesamten untersuchten Schwangerschaftsbereich unter denen der Kontrollgruppe, nach der 39. GW ist der Unterschied signifikant ($p < 0,05$). Die 10. Perzentile der Kontrollgruppe verläuft in der 37. GW bei 0,04 µg Zn/ml AF und erreicht in der 42. GW den Wert 0,14 µg Zn/ml AF. Darunterliegende Werte können als suspekt hinsichtlich negativer Einflüsse durch Hypotrophie, Diabetes mellitus oder Gestose angesehen werden. Erhöhte AFZL treten nach der 34. GW nur bei Fällen von infans mortuus auf. Zn hat eine wichtige Funktion für die antibakterielle Aktivität des AF. So sind z. B. beim Amnioninfektionssyndrom die Zinkwerte des AF reduziert. Die Bestimmung des AFZL könnte deshalb für die Früherkennung solcher Infektionen von Bedeutung werden.

Die lange Zeit gültige Meinung, daß ein Zinkmangel in der menschlichen Ernährung bei der weiten Verbreitung dieses Spurenelementes nicht zu erwarten ist, muß heute revidiert werden. Mangelhafte Zinkversorgung des Organismus führt neben anderen Störungen eindeutig zu einem verringerten Wachstum, was nach den vorliegenden Untersuchungen auch für die Schwangerschaft von großer Bedeutung zu sein scheint. Tierexperimente und Therapieversuche an zinkmangelversorgten Bevölkerungsgruppen haben gezeigt, daß die alimentär verursachten Zinkmangelzustände und sogar einige medikamentöse oder krankheitsbedingte Störungen auf eine orale oder parenterale Zinktherapie gut und schnell ansprechen. Ein frühzeitiges Erkennen von Zinkmangelzuständen in der Schwangerschaft könnte somit neue Möglichkeiten der Therapie eröffnen.

Schlüsselworte: Diabetes mellitus, Fetalüberwachung, Fruchtwasser, Gestose, Hypotrophie, Mangelentwicklung, Proteine, Risikoschwangerschaft, Zink.

Résumé

L'intérêt de la mesure du zinc dans le liquide amniotique. 2e Communication: Le zinc dans les cas de haut risque foetal

Des tests effectués à grande échelle sur des animaux et d'autres sur des êtres humains ont permis d'établir que la capacité de stockage de l'organisme pour le zinc (Zn) est très limitée et qu'il n'existe pas d'organe de stockage propre pour cet oligélément. Durant la grossesse en particulier, une carence nutritive de zinc entraîne rapidement une carence générale de zinc qu'il n'a pas été possible jusqu'à maintenant de détecter à temps, encore moins de soigner. C'est pourquoi nous nous sommes proposés dans cette étude d'examiner le degré de corrélation entre la malnutrition foetale et la teneur en zinc ou la teneur totale en protéine du liquide amniotique (LA); nous avons utilisé à cet effet des méthodes décrites dans la Partie I de cette publication [10]: la spectrophotométrie de l'absorption d'atomes pour la mesure du zinc et une méthode Biuret adaptéé au liquide amniotique pour la mesure totale de protéine.

Les examens ont porté sur divers groupes à risque, dont les résultats ont été comparés avec 230 cas d'un groupe de contrôle.

Les résultats montrent que la hausse importante de la teneur en zinc du liquide amniotique dans le groupe de contrôle à partir de la 38e semaine de gestation (Gestation Week 'WG') et atteignant jusqu'á trois fois le niveau initial est apparue seulement sous forme affaiblie dans 123 cas d'hypotrophie légère ou grave. C'est ainsi que les taux de zinc dans le liquide amniotique (Amniotic Fluid Zinc Levels: AFZL) sont nettement plus bas vers la fin du troisième trimestre que dans le groupe de contrôle. La différence conforme au «U-test» est significante à $p < 0{,}01$. La différence de concentration relevée à partir de la 38e semaine de gestation se situe aux alentours de 0,05 µg Zn/ml LA.

Le calcul de la teneur totale en protéine du liquide amniotique ne semble pas être une méthode appropriée pour le dépistage d.une hypotrophie du fait qu'il ne montre aucune différence importante avec le groupe de contrôle. Cependant, on relève une tendance identique entre la teneur de zinc et de protèine vers la fin de la grossesse. Comparés au groupe de contrôle, 36 cas de **gestose EPH** ont fait état de taux de zinc beaucoup plus élevés à la 32–33e semaine de gestation et beaucoup plus bas à la 40–41e WG ($p < 0{,}05$). Il nous semble que cela est dû à la mobilisation accrûe de protéine consécutive à la perte de protéine qui, à cause du haut degré de liaison du zinc avec l'albumine, se trouve combinée avec une perte de zinc.

Néanmoins, des tests effectués sur le liquide amniotique de 61 parturientes présentant des **conditions de metabolisme diabétique** ont donné un autre résultat. Les taux de zinc se situent ici au-dessous de ceux du groupe de contrôle tout au long de la période de grossesse sous observation. La différence est importante après la 39e semaine de gestation ($p < 0{,}05$) Le 10e percentile du groupe de contrôle monte jusqu'à 0,04 µg Zn/ml LA dans la 37e semaine et atteint le taure de 0,14 µg Zn/ml LA dans la 42e semaine. Les taux situés au-dessous de cette ligne peuvent être considérés comme suspects à la suite d'influences négatives dûes à l'hypotrophie, au diabètis mellitus ou à la gestose. Les hausses des taux de zinc dans le liquide amniotique après la 34e semaine de gestation ne surviennent que dans les cas de mort foetale intra-utérine ou de liquide amniotique vert. De plus, le zinc a une fonction importante pour l'activité antibactérielle du liquide amniotique. Par exemple, **les taux de zinc du liquide amniotique sont réduits dans le syndrome d'infection amniotique** et le calcul de l'AFZL (taux du zinc dans le liquide amniotique) pourrait donc aider à diagnostiquer rapidement de telles infections.

Il importe de réviser aujourd'hui la supposition admise pendant longtemps et selon laquelle la carence de zinc dans la nutrition humaine n'est pas à craindre étant donné la présence étendue de cet oligélément. Un apport insuffisant de zinc dans l'organisme provoque sans aucun doute – outre d'autres troubles – une croissance atrophiée qui, selon les investigations antérieures, semble avoir une grande influence sur la grossesse. Des expériences animales et des tests thérapeutiques effectués sur des groupes de personnes atteintes d'une carence en zinc ont montré que les déficiences alimentaires en zinc et même certains troubles médicaux ou maladifs peuvent être contrecarrés rapidement et avec succès par une thérapie orale ou parentérale de zinc. Un dépistage précoce d'une carence en zinc en cours de grossesse pourrait donc ouvrir de nouvelles possibilités de traitement.

Mots-clés: Contrôle foetal, diabetes mellitus, gestose, grossesse à risque, hypotrophie, liquide amniotique, malnutrition, protéines, zinc.

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